THE PHENOGRAM, A METHOD OF DESCRIPTION FOR STUDIES ON OXACIS (COLEOPTERA, OEDEMERIDAE)[1]

By Ross H. Arnett, Jr.[2]

The Phenogram

The data reported in this paper are of a preliminary nature, like most taxonomic data, and are used here only as a means of grouping possible evolutionary units. This will enable the reporting of future data without entirely repeating this information. For several years the genus *Oxacis* has been under intensive study. The following treatment of the species is to be considered as taxonomic only and does not constitute a review of the genus. A complete review of the genus is underway and will include data on the evolution of this group of natural species.

The recent articles by Ehrlich and Holm (1962), and Sneath and Sokal (1962), even if parts may be otherwise rejected by many practicing taxonomists, make two very important points: 1) the grouping of organisms into taxonomic units must be done in such a way that the work can be repeated by others, i.e., a description should be objective; 2) present day descriptive taxonomy, for the most part, is outmoded and must rapidly develop new methods that not only will be empirical but scientific as well. In this respect, these authors have performed a very important act—they have awakened some more systematists and have made them evaluate their techniques in the light of modern theories.

The following account of characteristics used in distinguishing specimens with locality data is a preliminary documentation useful for further studies on the variations among the living *Oxacis* beetles. As a working hypothesis only, the assumption is made that these features are under direct genetic control, either by a single gene, or by a gene complex. This remains to be proven and is currently under study. However, at the present time, there is no direct evidence for any of these assumptions. The final results will be available only after some years of study. Meanwhile, it seems useful to have these keys and descriptions available for the more ordinary identification work still required.

Descriptive characteristics.—The following features, in proper combination, will define any population of *Oxacis* beetles so far known in the North American and West Indian area. This includes all known intraspecific variations as well as interspecific differences. The key which follows shows how these populations have been grouped into taxonomic species. These features, it should be emphatically stated, do NOT define the genus, and do NOT define the species. There are many more features to be considered before such definitions are possible, e.g., internal anatomy, habits, distribution, and others.

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The following list of characters and states refer to the position on the phenograms. Each characteristic is numbered, such as, head color is number 1, head maculation is number 2, etc. Then, each state of each characteristic is given a value from 1 to 10 and is placed after a decimal point following the characteristic number, such as, head color pale is number 1.1, head color tan is number 1.2, etc. If in the following list certain numbers are not used because those states have not been observed, those numbers are put in parentheses, such as, the states of head maculation covered by the numbers 2.2-2.9.

HEAD CHARACTERS.—1. *Color:* 1.1 Pale; 1.2 Tan; 1.3 Yellow; 1.4 Orange; 1.5 Fuscus; 1.6 Piceus; 1.7 Metallic blue; 1.8 Metallic green; (1.9); 1.10 Lead. 2. *Maculation:* 2.1 Immaculate; (2.2; 2.3; 2.4; 2.5; 2.6; 2.7; 2.8; 2.9) 2.10 Central spot. 3. *Pubescence texture:* 3.1 Fine; 3.2 Moderate; (3.3; 3.4; 3.5) 3.6 Coarse; (3.7; 3.8; 3.9) 3.10 Very coarse. 4. *Pubescence distribution:* 4.1 Fine; 4.2 Moderate-recumbent; 4.3 Moderate, erect; 4.4 Dense, recumbent; 4.5 Dense, erect; (4.6; 4.7; 4.8; 4.9) 4.10 Dense, recumbent and erect. 5. *Pubescense color:* 5.1 White; 5.2 Yellow; 5.3 Brown; (5.4; 5.5; 5.6) 5.7 Black; (5.8) 5.9 Brown and white; 5.10 Brown and black. 6. *Punctation:* 6.1 Fine; 6.2 Moderate; (6.3; 6.4; 6.5) 6.6 Coarse; (6.7; 6.8; 6.9) 6.10 Rugose. 7. *Punctation distribution:* 7.1 Spare; (7.2; 7.3; 7.4; 7.5) 7.6 Moderate; (7.7; 7.8; 7.9) 7.10 Dense. 8. *Interspaces*: 8.1 Smooth; (8.2; 8.3; 8.4) 8.5 Micro-reticulate; (8.6; 8.7; 8.8; 8.9) 8.10 Rugose. 9. *Mandible size:* 9.1 Short; (9.2; 9.3; 9.4) 9.5 Moderate; (9.6; 9.7) 9.8 Elongate; (9.9) 9.10 Elongate, deflexed. 10. *Mandible shape:* 10.1 Stout; (10.2; 10.3; 10.4; 10.5) 10.6 Apex acute; (10.7; 10.8; 10.9) 10.10 Apex blunt. 11. *Antennal segments:* 11.1 Elongate-parallel; (11.2; 11.3) 11.4 Normal; (11.5) 11.6 Long, normal; (11.7) 11.8 Fusiform; (11.9) 11.10 Elongate, deflexed. 12. *Antennal color:* 12.1 Pale; 12.2 Tan; 12.3 Yellow; 12.4 Orange-red; 12.5 Fuscus; 12.6 Piceus; 12.7 Metallic blue; 12.8 Metallic green; (12.9) 12.10 Lead.

THORAX CHARACTERS.—13. *Color:* 13.1 Pale; 13.2 Tan; 13.3 Yellow; 13.4 Orange-red; 13.5 Fuscus; 13.6 Piceus; 13.7 Metallic blue; 13.8 Metallic green; (13.9) 13.10 Lead. 14. *Maculation:* 14.1 Immaculate; 14.2 Lateral spots only; 14.3 Central stripe; 14.4 Trimaculate; 14.5 Vertical narrow stripe; 14.6 Central stripe; 14.7 Cross bar; (14.8; 14.9) 14.10 Anterio-lateral mirror spot. 15. *Depressions:* 15.1 None; (15.2) 15.3 Basal; 15.4 Anterior-lateral; (15.5) 15.6 Central; (15.7; 15.8; 15.9) 15.10 Tri-impressed. 16. *Pubescence texture:* 16.1 Fine; (16.2; 16.3) 16.4 Moderate; (16.5) 16.6 Coarse; (16.7; 16.8; 16.9) 16.10 Very coarse. 17. *Pubescence distribution:* 17.1 Sparse; (17.2; 17.3; 17.4) 17.5 Moderate; (17.6; 17.7; 17.8; 17.9) 17.10 Dense. 18. *Pubescence color:* 18.1 White; (18.2) 18.3 Yellow; (18.4) 18.5 Brown; (18.6) 18.7 Black; (18.8) 18.9 Brown and white; 18.10 Brown and black. 19. *Pubescence position:* 19.1 Antrose-recumbent; 19.2 Antrose-erect; (19.3; 19.4) 19.5 Antrose, retrose posteriorly; (19.6) 19.7 Antro-recumbent and erect; (19.8; 19.9) 19.10 Recumbent latero-mesiad. 20. *Shape:* 20.1 Medially constricted; (20.2) 20.3 Convergent posteriorly; (20.4) 20.5 Strongly constricted; (20.6; 20.7; 20.8; 20.9) 20.10 Rounded. 21. *Punctation:* 21.1 Fine; (21.2;

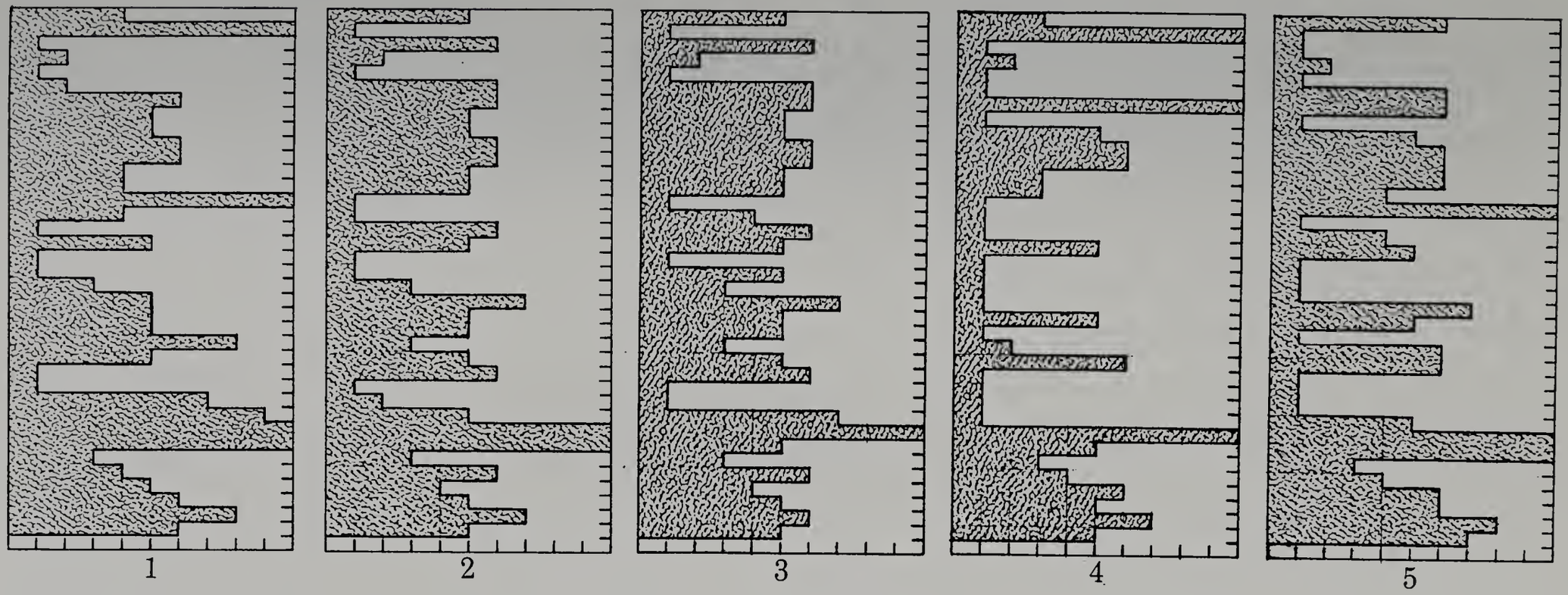
21.3; 21.4) 21.5 Moderate; (21.6) 21.7 Coarse; (21.8; 21.9) 21.10 Rugose. 22. *Punctation distribution:* 22.1 Sparse; (22.2; 22.3; 22.4) 22.5 Moderate; (22.6; 22.7; 22.8; 22.9) 22.10 Dense. 23. *Interspaces:* 23.1 Smooth; (23.2; 23.3; 23.4) 23.5 Micro-reticulate; (23.6; 23.7; 23.8; 23.9) 23.10 Rugose. 24. *Leg color:* 24.1 Pale; 24.2 Yellow; 24.3 Fuscus; 24.4 Piceus; (24.5) 24.6 Basally piceus; (24.7; 24.8; 24.9) 24.10 Basally red.

ELYTRA CHARACTERS—26. *Pubescence texture:* 26.1 Fine; (26.2; 26.3) 26.4 Moderate; (26.5) 26.6 Piceus; (26.7; 26.8; 26.9) 26.10 Very coarse. 27. *Pubescence color:* 27.1 White; (27.2) 27.3 Yellow; (27.4) 27.5 Brown; (27.6) 27.7 Black; (27.8) 27.9 Brown and white; 27.10 Brown and black. 28. *Costae:* 28.1 Obscure; 28.2 Raised; 28.3 Raised, pubescent; (28.4) 28.5 Pubescent only; (28.6) 28.7 Orange; (28.8; 28.9) 28.10 Outlined. 29. *Maculation:* 29.1 Immaculate; 29.2 Narrow central stripe; 29.3 Two stripes; (29.4) 29.5 Sutural only; 29.6 Submarginal only; 29.7 Sutural and marginal; 29.8 Marginal and submarginal; 29.9 All three; 29.10 Black. 30. *Punctation:* 30.1 Smooth; (30.2; 30.3; 30.4) 30.5 Moderate; (30.6) 30.7 Coarse; (30.8; 30.9) 30.10 Rugose. 31. *Interspaces:* 31.1 Smooth; (31.2; 31.3; 31.4) 31.5 Microreticulate; (31.6; 31.7; 31.8; 31.9) 31.10 Rugose. 32. *Elytra shape:* 32.1 Narrow; (32.2) 32.3 Moderate; (32.4; 32.5; 32.6; 32.7; 32.8; 32.9) 32.10 Moderate, blunt.

BODY IN GENERAL.—33. *Body shape:* 33.1 Very narrow; (33.2; 33.3) 33.4 Narrow; (33.5) 33.6 Moderate; (33.7) 33.8 Broad; (33.9) 33.10 Very broad.

BODY MEASUREMENTS.—34. *Total length:* 34.1, 1.00-5.00 mm.; 34.2, 5.01-6.00 mm.; 34.3, 6.01-7.00 mm.; 34.4, 7.01-8.00 mm.; 34.5, 8.01-9.00 mm.; 34.6, 9.01-10.00 mm.; 34.7, 10.01-11.00 mm.; 34.8 11.01-12.00 mm.; 34.9, 12.01-13.00 mm.; 34.10, over 13.01 mm. 35. *Head length/width ratio:* 35.1 less than .5000; 35.2, .5001-.6000; 35.3, .6001-.7000; 35.4, .7001-.8000; 35.5, .8001-.9000; 35.6, .9001-1.0000; 35.7, 1.0001-1.1000; 35.8, 1.1001-1.2000; 35.9, 1.2001-1.3000; 35.10, over 1.3001. 36. *Pronotum length/width ratio:* 36.1 less than .5000; 36.2, .5001-.6000; 36.3, .6001-.7000; 36.4, .7001-.8000; 36.5, .8001-.9000; 36.6, .9001-1.0000; 36.7, 1.0001-1.1000; 36.8, 1.1001-1.2000; 36.9, 1.2001-1.3000; 36.10, over 1.3001. 37. *Elytra length/width ratio:* 37.1 less than 2.000; 37.2, 2.0001-2.2000; 37.3, 2.2001-2.4000; 37.4, 2.4001-2.6000; 37.5, 2.6001-2.8000; 37.6, 2.8001-3.0000; 37.7, 3.0001-3.2000; 37.8, 3.2001-3.4000; 37.9, 3.4001-3.6000; 37.10, over 3.6001.

A detailed discussion of these features would occupy too much space here, and they have already been described in some detail in two previous papers (Arnett, 1958, 1960). Some mention must be made of the method used to assign the characters to a particular position. As can be seen from the preceding listing of characters, there are 37 characteristics used, each with ten possible states, representing ten conditions. Not all of these 370 possible positions on the phenograms are used. The system is, to some degree at least, an open-end system. If new features are noted, the vacant states may be assigned without disrupting the usefulness of previous work. Obviously, additional states and characters can be added if needed. But this would result in the necessity of a reorganization of the table which



FIGURES 1-5. Phenograms of new species of *Oxacis*. 1—*O. bernadettei*, n. sp. 2—*O. francesca*, n. sp. 3—*O. matthewi*, n. sp. 4—*O. michaeli*, n. sp. 5—*O. josephi*, n. sp.

The phenogram is to be read from top to bottom and left to right. The scale on the right side of each phenogram marks off the position of each of the 37 characters used in this study. The top darkened bar represents character number 1, and so on down the graph. The scale along the bottom of each phenogram marks off the ten states for each of the characters. Thus the bar representing each character is filled in to the position that represents the state of that particular character for the species represented. This position is numbered in the description given in the text. Thus it is possible to read the histogram in terms of characters and states by locating the position by number and referring to the text. The general pattern of the phenogram is useful *per se* for comparing species and species group, however.

would mean that previous work would have to be transferred to the new system. The order given to these features is purely arbitrary because there is little direct evidence at the moment that one state of a character is any more advanced, i.e., evolved, than another. However, the order of the states is such that they progress from a simpler to a more complex condition so far as it is possible to make such an arrangement. This does not apply to the length data or to the treatment of the length/width ratio. In these cases a mid point may be considered as the least complex.

In evaluating these features, first the individuals from a single locality are carefully studied to determine which of these characters are subject to variation and which remain stable. In a great many cases living specimens in a single area have been studied. Where several sympatric species are represented the limits of the variation for some of the populations are definitely known. That is, it is believed that species are represented in such areas because here the limits of the several populations can be seen clearly. Using this sort of information it is believed that all such populations as represented in our collections can be evaluated. There will remain, of course, odd specimens here and there in the collections that cannot be placed until a series is available. This process is still to be completed for the material now accumulated, and it is for this reason that these data are preliminary.

By using this system of character and state study, the five species described as new in this paper are characterized. To show graphically the pattern of characters in these populations, there is presented for the first time, a modified histogram, here called a phenogram. (Figures 1-5). For each of these species, I have hypothesized that genetic data would show that these states are related and that the variation from one population to another is the result of gene combinations and changes. It is possible that something very similar to this actually did occur in nature. This is based on the fact that studies in other groups where the genetics is known have shown a similar pattern of character relationships. This paper deals with alpha taxonomic problems, and, therefore, there is no obligation to go farther with this study. I submit that the experimental systematist may devise ways of testing this hypothesis. This is the value of the phenogram. Similar devices have been used by other authors, but, so far as I am aware, not in this way. It is called a phenogram because it graphically portrays the phenotype of the species. It represents the size, shape, color, and structure of the members of the population studied. Phenograms say nothing more than that contained in a description. However, to those who are conscious of the efforts in the direction of numerical taxonomy, it is apparent that this treatment of characters readily lends itself to statistical comparison in all of its aspects and techniques. Phenograms may be readily compared visually, and, if arranged on sorting cards, they may be treated mathematically. The remainder of this paper, including the key to species, is an example of the application of this method.

In the introduction above, the terms "evolutionary units" and "natural species" are used. An explanation of the meaning of these expressions is necessary because of the complexity of the nomenclature currently applied to what was once generally, if casually, called species. I have no intention

of adding to this confusion, but with the variety of connotations for the word "species" it is necessary that an author explain what he has in mind when he presents the data he has gathered. The term evolutionary unit (see Ehrlich and Holm, 1962, p. 656) here means a single living group of organisms living together and interbreeding as a local community. We know them only as samples taken from the field by the ordinary sampling methods, and studied by comparing them with similar samples taken from other areas. It is believed that these samples represent members of a local, interbreeding community of organisms. They are called evolutionary units because it is these local communities that are capable of maintaining the gene flow, and such groups will express the variation that is the potential source of evolutionary change. The descriptions of the new species published here are each based on a single such evolutionary unit because these units are at this time thought to represent distinct species since they have been compared with similar units, either from the same locality or elsewhere. There are specimens from other nearby areas for each of these new species, but they are not included in the description for the reason that they have not as yet been studied for a sufficient number of characters to show that they are actually a part of the same breeding or potentially interbreeding population. The advantage of basing formal descriptions on single samples should be obvious. It permits an objective means of referring to a single group when further work shows that more than one species is involved, or perhaps, when synonymy is discovered. This is thought to be a way to keep nomenclatural problems to a minimum and to allow the addition of zoological data without becoming involved in the time consuming task of untangling nomenclature.

The term natural species cannot be adequately defined in brief terms. For the present study it is sufficient to say that it represents a collection of evolutionary units, all thought to be part of a breeding or potentially interbreeding group of individuals as represented by samples taken from the field. It is used to make a distinction between groups based on studies using all possible biological data, the natural species, and taxonomic species that are based on the study of museum species using the classical morphological characters only. By making this distinction, it is possible to correlate the previous literature and nomenclature with current biological studies.

DESCRIPTIONS OF NEW SPECIES

The following new species are dedicated to my children who have shared with me many pleasant months in the desert in Arizona and Mexico studying the habits of *Oxacis*. All measurements made in this study follow the procedure described in Arnett (1960).

Oxacis bernadettei Arnett NEW SPECIES

(Fig. 1)

The presence of two anterior laterally placed mirror spots makes this species easy to distinguish from *O. barbara* Arnett which it otherwise resembles. This species belongs in the Subfusca group.

Holotype: Male, TEXAS, Burkburnett, Red River, Wichita Co., June 26, 1948 (C. and P. Vaurie). Deposited in the collection of the American Museum of Natural History.

Description.—Head orange-red in color with a central dark spot; pubescence fine, white; punctation moderate, interspaces microretriculate. Mandibles moderate in length with apices acute. Antennae normal with the segments elongate, parallel-sided.

Thorax orange-red in color; pronotum with a dark lateral spot on each side and a dark central stripe; in addition, at approximately the same location as the lateral spots, but not coincident with them are mirror spots, smooth, denuded areas that are very shiny; pronotal surface with an anterior-lateral depression on each side; pubescence fine, white, recumbent, antrorose posteriorly; pronotal shape obovate, sides convergent posteriorly, only slightly constricted at the center; punctation moderate; interspaces microretriculate. Legs piceus, with the base of the femora, and the coxae orange-red; metafemora normal, not enlarged.

Elytra fuscus; pubescence fine, recumbent, white; costae raised, orange in color; sutural and submarginal stripes evident; surface rugose; shape convex with the apices rounded, with sutural angles acute.

Abdomen fuscus.

Body shape elongate, narrow; length 8.7 mm.; head length/width ratio, .9302; pronotum length/width ratio, 1.0227; elytra length/width ratio, 2.6153.

Allotype: Female, same data as the holotype.

Paratypes.—Same data as the holotype; 19 males and 19 females.

Larvae: Unknown.

Biology: Unknown.

Variation: These specimens are remarkably uniform, with no significant difference between the sexes to indicate secondary sexual dimorphorism. The mean length of all 40 specimens is 8.6 mm.; mean head length/width ratio, .9575; mean pronotum length/width ratio, 1.1196; mean elytra length/width ratio, 2.7031.

Oxacis francesca Arnett NEW SPECIES

(Fig. 2)

This species has the general appearance of *O. sericea* Horn, but lacks the powdery gray color of that species. It may be easily recognized by the pale elytral costae and uniform dark fuscus color. This species belongs in the Subfusca group.

Holotype: Male, CALIFORNIA, Bakersfield, July 8, 1928 (Ray F. Smith). Deposited in the California Academy of Sciences collection.

Description.—Head fuscus, immaculate; pubescence coarse, white; punctation coarse, interspaces microretriculate; mandibles moderate, apices acute; antennae normal, segments elongate and parallel-sided.

Thorax fuscus; pronotum immaculate, without depressions; pubescence coarse, white, recumbent, antrorose posteriorly; pronotal shape obovate with sides convergent posteriorly without pronounced constriction at the center; punctation coarse, interspaces microretriculate. Legs fuscus, metafemora normal, not enlarged.

Elytra fuscus; pubescence coarse, long, some setae erect, most recumbent, white; costae raised and pubescent; both sutural and marginal stripe pale; surface rugose; shape convex with apices rounded, sutural angles acute.

Abdomen fuscus.

Body shape moderately broad; length, 8.0 mm.; head length/width ratio, .7500; pronotum length/width ratio, 1.1428; elytra length/width ratio, 2.6666.

Allotype: Female, same data as the holotype.

Paratypes: Same data as holotype, 3 males and 12 females.

Larvae: Unknown.

Biology: Unknown.

Variation: This short series shows little variation except for one female which is paler than the others. There are no evident secondary sexual differences. The mean values for the 17 speciemens are: length, 7.8 mm.; head length/width ratio, .8530; pronotum length/width ratio, 1.0918; elytra length/width ratio, 2.7348.

Oxacis matthewi Arnett NEW SPECIES

(Fig. 3)

The unusual condition of the posteriorly directed pronotal pubescence sets this species apart from the others of this group. The uniform fuscus color and coarse pubescence distinguishes it from *O. rugicollis* Champion, to which it is very similar. This species belongs to the Subfusca group.

Holotype: Male, MEXICO, Estero de Sargente, 23 km. S. Desemboque, August 11, 1953 (B. Malkin). Deposited in the California Academy of Sciences collection.

Description.—Head fuscus, immaculate; pubescence coarse, recumbent, moderate in density, white; punctation coarse, moderate in density, interspaces microretriculate. Mandibles moderate in length, apices acute. Antennae with segments normal, segments elongate and nearly parallel-sided.

Thorax fuscus; pronotum immaculate; pronotal surface with an anterior-lateral depression on each side; pubescence coarse, moderately dense, white, recumbent, retrose posteriorly. Pronotal shape obovate with sides convergent posteriorly, very slightly constricted at the center; punctation coarse, moderate in density, interspaces microretriculate. Legs fuscus; metafemora normal, not enlarged.

Elytra fuscus; pubescence coarse, recumbent, moderate in density, white; elytral costae obscure; pale sutural and marginal stripe evident but not pronounced; surface rugose, interspaces microretriculate; elytra convex, apices rounded with sutural angles acute.

Abdomen fuscus.

Body shape moderately elongate; length 8.0 mm.; head length/width ratio .8947; pronotum length/width ratio 1.0714; elytra length/width ratio 2.7857.

Allotype: Female, same data as the holotype.

Paratypes: Same data as holotype; 19 males; 7 females, and 10 sex undetermined.

Larvae: Unknown.

Biology: Unknown.

Distribution: Known only from northern Sonora, Mexico.

Variation: The size ranges from 5.8 to 9.5 mm. in length, with no marked sexual difference in length. The mean length of the males is 7.6 mm., and the females 7.9 mm. The pronotum of the males seems to be narrower than those of the female. The mean ratio of pronotum length/width in the males is 1.0100; that of the females, .9700. There is some color variation; some of the specimens are paler than the majority.

Oxacis michaeli Arnett NEW SPECIES

(Fig. 4)

The rather pale pronotum and dark brownish elytra gives this species a superficial resemblance to *Xanthochroina bicolor* (LeConte), but it is otherwise similar to *O. cana* (LeConte). It is assigned to the Trimaculata group.

Holotype: Male, CALIFORNIA, Stovepipe Wells, Death Valley National Park, April 6, 1928. Deposited in the California Academy of Sciences collection.

Description.—Head yellow with a dark central spot; pubescence texture fine, moderately dense, white; punctation fine, sparse, the interspaces smooth. The mandibles are moderate in length with the apices acute. The antennal segments are elongate and nearly parallel-sided.

Thorax yellow, immaculate, without pronotal depressions; pubescence texture fine, moderately dense, white, recumbent, antrorse posteriorly on the pronotum; pronotum constricted laterally at the middle; punctation fine, the interspaces smooth. Legs entirely yellow.

Elytra piceus, immaculate; pubescence texture fine, white; costae not evident; surface rugose, interspaces microretriculate; shape convex with inner apical angles acute.

Abdomen piceus.

Body narrow, elongate; length 8.8 mm.; head length/width ratio, .9333; pronotum length/width ratio 1.1162; elytra length/width ratio 2.7868.

Allotype: Female, same data as the holotype.

Paratypes: Same data as the holotype; 2 males and 4 females.

Larvae: Unknown.

Biology: Unknown.

Distribution: Known only from Death Valley, California.

Variation: The color, pubescence, and punctation show no particular variation in this short series. The only sexual dimorphism exhibited in the series is a mean size difference. The mean length of the males is 8.5 mm.; of the females is 9.9 mm.

Oxacis josephi Arnett NEW SPECIES

(Fig. 5)

The rather narrow body gives this species an elongate appearance. This along with the shiny median stripe and the small, shiny anterior-lateral mirror spots are the distinguishing features of this species. It is otherwise very similar to some of the forms of *O. cana* (LeConte) and it belongs in the Trimaculata group.

Holotype: Male, MEXICO, 15 km. E. Sombrete, Zacatecas, July 28-31, 1951 (H. E. Evans). Deposited in the United States National Museum collection.

Description.—Head piceus, immaculate; pubescence fine, white; punctation coarse, interspaces smooth; mandibles moderate in length, apices acute; antennae normal, the segments elongate and parallel-sided.

Thorax orange-red; pronotum with a central spot and with an anterior-lateral mirror spot on each side; pronotal surface without depressions; pubescence moderate, white, recumbent, antrose posteriorly; pronotal shape obovate with sides constricted at the middle; punctation coarse, interspaces smooth; legs piceus, base of femora and coxae orange-red; metafemora normal, not enlarged.

Elytra piceus; pubescence fine, white; costae obscure; pale sutural stripe evident; surface rugose; shape convex, apices rounded, sutural angles acute.

Abdomen piceus.

Body shape elongate, narrow; length 9.6 mm.; head length/width ratio .9534; pronotum length/width ratio 1.1428; elytra length/width ratio 2.9242.

Allotype: Female, same data as the holotype.

Paratypes: Same data as the holotype; 8 males and 12 females.

Larvae: Unknown.

Biology: Unknown.

Distribution: Known only from central Mexico.

Variation: The series upon which this species is based is remarkably uniform, but the other specimens which may belong to this species show considerable variation. I do not know this species from my own field work. It is interesting to note that the anterior lateral black spots on the pronotum do not coincide with the mirror spots, although they always overlap. It would seem from this, that the genes responsible for these character states are quite distinct. The fact that mirror spots appear in other species independent of the pronotal maculations seems to indicate that separate genes may appear as dominant characters in various segments of the genus quite independent of other characteristics. This is one example for support of the deduction that the characters used in the phenogram have a genetic basis even if there has been, as yet, no experimental data in support of the hypothesis. Sexual dimorphism is indicated by the mean length: males, 9.3 mm.; females 10.5 mm. Also the elytra of the males are longer than those of the female: male elytra length/width mean ratio, 3.1000; female 2.9820.

DETERMINATION KEYS

The following key to the species includes all known species occuring north of Colombia, including the West Indies, Central, and North America. So far as it is now known, the genus does not occur outside of the New World. There are many species described from Brazil and Argentina, most of which are known only from the type specimens. Until these have been examined, a useful key to all of the species of the genus cannot be constructed.

I. KEY TO THE SPECIES GROUPS OF OXACIS

1. Body narrow; color pale to tan or yellow, or if brownish, body wide and pubescence coarse; elytra with or without black stripes; antennal segments may be short and fusiform (Key II) ---------- FRAGILIS GROUP
   Body usually narrow, if broad, color fuscus or brownish; color usually orange-red and piceus, entirely dark, or if pale, body not immaculate; antennal segments elongate and parallel-sided ---------- 2

2(1). Vestiture very coarse and dense, obscuring punctation (Key III) -------- PALLIDA GROUP
   Vestiture coarse to fine, but not obscuring punctation, or if coarse and with costae, then not light tan in color ---------- 3

3(2). Head, thorax, and elytra entirely dark, metallic or lead colored, without pale markings on elytra (Key IV) ---------- **PLUMBEA GROUP**
Head, thorax, and elytra fuscus or reddish-brown, or if nearly piceus, then with pale markings on thorax and rarely on elytra (Key V) ---------- **SUBFUSCA GROUP**
Thorax orange-red or testaceous, with or without darker markings, or if head, thorax, and elytra are dark, then pale sutural and marginal stripes on elytra (Key VI) ---------- **TRIMACULATA GROUP**

II. KEY TO THE SPECIES OF THE FRAGILIS GROUP

1. Pubescence of elytra of two distinct colors and texture ---------- 2
Pubescence of uniform, or nearly uniform color throughout ---------- 3
2(1). Coarse brown, erect hairs scattered throughout white, more recumbent hairs on elytra in proportions varying from nearly equal of each to a very few erect brown hairs located mainly toward apex and sutural areas of elytra ---- **BITOMENTOSA** Arnett
Brown hairs in patches on elytra otherwise covered with white hairs, giving surface a variegated appearance ---------- **VARIEGATA** Champion
3(1). Antennae with segments fusiform, short and broad in shape; body usually very pale in color, immaculate ---------- **MEGATHORACICA** Arnett
Antennae with segments elongate, parallel-sided; body pale to tan or yellow, with or without distinct black markings ---------- 4
4(3). Body pale to tan or light brown, immaculate ---------- 7
Body yellowish, always with blackish to dark brown markings ---------- 5
5(4). Elytra without black or dark brown stripes; body entirely reddish-yellow except for apex of femora and remainder of legs and antennae black -- **CONSTRICTICOLLIS** Champion
Elytra with a distinct narrow black or dark brown stripe on each elytron ---------- 6
6(5). Black stripe on each elytron entire ---------- **BILINEATA** Champion
Black stripe on each elytron absent at basal half except for small black spot at base ---------- **PICTIPENNIS** Champion
7(4). Color pale; pubescence fine; surface somewhat shiny ---------- **FRAGILIS** Horn
Color tan to light brown; pubescence coarse; surface dull ---------- **XERENSIS** Arnett

III. KEY TO THE SPECIES OF THE PALLIDA GROUP

1. Elytra with costae ---------- 2
Elytra without costae ---------- 3
2(1). Color dark with light central black stripe on elytra (northern and central part of range) ---------- **PALLIDA** LeConte
Color light tan with central black stripe on elytra (southern and western part of range) ---------- **PALLIDA** LeConte
3(1). Color tan (variant) ---------- **SERICEA** Horn
Color slate (variant) ---------- **SERICEA** Horn

IV. KEY TO THE SPECIES OF THE PUMBEA GROUP

1. Legs pale, body bluish-metallic ---------- **DURANGOSA** Pic
Legs dark ---------- 2
2(1). Body entirely bluish or greenish metallic in color; thorax only slightly narrower behind, widest near middle ---------- **CAERULEA** Champion
Body black, lead-colored, without metallic reflections; thorax widest in front, abruptly narrowed behind middle and base much narrower than apex -------- **PUMBEA** Champion

V. KEY TO THE SPECIES OF THE SUBFUSCA GROUP

1. Entire surface shiny; punctations very sparse; elytral surface barely irregular; color fuscus; elytra darker, but with broad pale sutural area ---------- **NITENS** Arnett
Like preceding couplet, but with very broad, pale sutural area ---------- **KNULLI** Arnett
Surface of head and thorax shiny or dull, but elytra always dull, rugose ---------- 2
2(1). Costae of elytra distinctly outlined by double broken dark fuscus line; pubescence long, sub-erect; color dark brown ---------- **LINEATULA** Champion
Costae, if present, not outlined by broken line ---------- 3

3(2). Area between pronotal punctures reticulate to rugose, or if area smooth, then very dark brown (rarely specimens of GRANULATA) ---- 4
Area between pronotal punctures smooth or micro-punctate ---- 6
4(3). Elytra depressed, apex blunt, not tapering to apex, but nearly parallel for entire length, margin broadly excavated at center; metafemora of male greatly enlarged ---- **PODAGRICA** Champion
Elytra convex, apex pointed, widest near base, sides not emarginate; metafemora of male slender ---- 5
5(4). Color very dark brown; pubescence short, fine, depressed; pronotal punctures distinct, well formed ---- **GRANULATA** LeConte
Color brown; pubescence very long, fine, suberect; pronotal punctures coarse, very poorly formed ---- **PILOSA** Champion
6(3). Color uniformly reddish-brown; elytra rarely stained with piceus; thorax always as light as or lighter than elytra. ---- **SUBFUSCA** Horn
Color piceus-brown; elytra usually stained with piceus; thorax darker or as dark as elytra ---- 7
7(6). Head and pronotum shiny, piceus brown; head densely and finely punctate; elongate, narrow species, pubescence coarse ---- **ANGUSTATA** Champion
Head and pronotum not obviously shiny or piceus ---- 8
8(7). Each elytron marked with two orange striae ---- 9
Elytra at most with evident costae ---- 10
9(8). Pronotum without anterior-lateral mirror spots ---- **BARBARA** Arnett
Pronotum with two anterior-lateral mirror spots ---- **BERNADETTEA** Arnett
10(8). Body usually uniformly fuscus, with evident costae with white pubescence; pubescence moderate and usually rather coarse ---- **FRANCESCA** Arnett
Body maculate or pubescence coarse; elytra without evident costae ---- 11
11(10). Color uniformly brown; pubescence coarse, that of posterior portion of pronotum directed posteriorly ---- **MATTHEWI** Arnett
Pronotum with extreme base and apex reddish-brown, body otherwise dark; pubescence fine, that of posterior portion of pronotum directed anteriorly ---- **RUGICOLLIS** Champion

VI. KEY TO THE SPECIES OF THE TRIMACULATA GROUP

1. Pronotum with a wide, central dark brown or piceus stripe which has a distinct reddish bar transversely through the middle, and each side of thorax with a reddish patch ---- **TEAPENSIS** Champion
Pronotum immaculate, with piceus patch on each side, with a central piceus stripe, or with both lateral patch and central stripe ---- 2
2(1). Lateral margins of prothorax only stained with piceus, central stripe absent ---- 3
Prothorax immaculate, or with a central stripe only, or with a central stripe and lateral patches ---- 4
3(2). Pronotum very shiny, punctures fine, poorly formed; pubescence sparse (western North America) ---- **LAEVICOLLIS** Horn
Pronotum dull, punctures coarse, large, and closely placed (eastern United States) ---- **TAENIATA** (LeConte)
4(2). General color reddish-orange, elytra stained at base with piceus to entirely piceus; mandibles usually large; pronotum distinctly marked with central piceus stripe, and a piceus patch on each side ---- **TRIMACULATA** Champion
Elytra piceus or brown-piceus, with or without lateral markings, or if paler, not reddish-orange, mandibles not large, surface of a dusty appearance and thoracic markings not distinctly limited ---- 5
5(4). Pronotum with coarse yellow-brown pubescence on each side, absent at middle and along lateral margins, arranged in "combed," orderly fashion, directed toward median line; median stripe of thorax usually red, rarely with piceus staining; elytra with or without sutural, marginal, or submarginal pale stripes ---- **SECURICULA** Arnett
Pronotum without patches of coarse pubescence and not red ---- 6
6(5). Elytra variable, but always with distinct pale submarginal stripe ---- 7
Elytra always dark, and usually without pale submarginal stripe, or if pale stripe present, then poorly differentiated; head pale or dark ---- 9

7(6). Elytra with sutural and marginal area broadly pale, dark longitudinal area traversing center of each elytron with bluish luster----------**COAHUILAE** Champion
Elytra dark to pale, with variable pale submarginal stripe; central area of each elytron without bluish luster---------- 8

8(7). Thorax broad in front, length to width ratio 1:1; surface of thorax between punctures finely reticulate (W.I. and Fla.)----------**LAETA** (Waterhouse)
Thorax narrower in front, length to width ratio 5:4; surface of thorax smooth between punctures (La., Kans., Tex., Ariz., and Mexico)----------**CHAMPION** Arnett

9(6). Elongate species; thorax distinctly marked with shiny, usually short, piceus median stripe and small shiny piceus mirror spot on each side; elytra purple-piceus; body with a general dusty lead-colored cast----------**JOSEPHI** Arnett
Short and broad species; elytra immaculate, without costae---------- 10

10(9). Body shiny, thorax broad; pubescence yellow, fine----------**NITIDICOLLIS** Champion
Body surface dull; pubescence white to yellow, coarse to fine---------- 11

11(10). Apex of pronotum slightly emarginate; species generally over 7 mm. in length; pronotum broad and less abruptly constricted at middle---------- 12
Apex of pronotum generally evently arcuate; species 4.0-6.5 mm. in length generally; pronotum abruptly constricted behind middle and narrow------**MINUTA** Champion

12(11). Pronotum orange, immaculate with deep depressions on each side; elytra entirely piceus ----------**DUGESI** Champion
Pronotum orange, or pale, with or without piceus markings, and without obvious lateral depressions ---------- 13

13(12). Pronotum orange, usually with piceus markings; elytra purple-piceus, often with very narrow pale sutural and marginal stripe, rarely with vague sub-marginal pale stripe; pronotum rather sharply constricted behind apex----------**CANA** (LeConte)
Pronotum pale, yellow, immaculate; elytra dark brown to piceus without evident sutural or marginal stripe; sides of pronotum gradually narrowing to base ----------**MICHAELI** Arnett

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LITERATURE NOTICE

THE ANOBIIDAE OF OHIO (COLEOPTERA), by Richard E. White. Bulletin of the Ohio Biological Survey (New Series), Vol. 1, No. 4, x, 58 pp., 28 figs., 1962. (Price $1.00)—This is the fourth family of beetles treated in the Survey; the others, Cerambycidae, Cleridae, and Chrysomelidae, were treated by Knull and Wilcox. The anobiid manual includes 71 species in 28 genera, 52 of them having been found in Ohio, while the other 19 are discussed because they are known from one or more adjacent States and could occur in Ohio. Keys to subfamilies, genera, and species (often revised from Fall's 1905 anobiid revision), short synonymies, diagnostic descriptions, and distributions are given. One species of each genus, with two exceptions, is illustrated. The States of Ohio, Illinois, Connecticut, and California are still very active in producing insect manuals to the species level, and for this we should be thankful. The Pacific Northwest is being covered for the beetles by Hatch. Now, if some southern and southwestern States could put out such manuals, we would have at least the beginnings of a reasonable survey of the areas of the United States.